

Fishes of Buck Creek, Cumberland River Drainage, Kentucky

RONALD R. CICERELLO
*Kentucky Nature Preserves Commission,
Frankfort, Kentucky 40601*

AND

ROBERT S. BUTLER
*Department of Biology,
Eastern Kentucky University, Richmond, Kentucky 40475*

ABSTRACT.— Fifty-nine personal fish collections and museum records from thirty-nine sites in the drainage of Buck Creek, a major tributary to the upper Cumberland River below Cumberland Falls in Kentucky, revealed a total of seventy-three species and one hybrid, representing thirteen families. New records for the upper Cumberland River drainage in Kentucky included *Ictiobus bubalus*, *Ictalurus furcatus*, and *Lepomis microlophus*. *Notropis ariommus* and *Etheostoma cinereum*, two species assigned protection status in Kentucky, are known from Buck Creek, but *E. cinereum* has not been collected since 1955. Analysis of faunal resemblance of species collected at twenty-one sites along the Buck Creek mainstem revealed three faunal units. The pattern of longitudinal distribution along the mainstem involved addition of species in the middle stream section to those present in the upper section and replacement in the lower section by forms typical of low-gradient, big-river habitats.

INTRODUCTION

The upper Cumberland River basin upstream from the Tennessee border drains 13,416 sq km of eastern Kentucky (Mayes et al. 1975) and contains many of the highest quality streams remaining in Kentucky (Harker et al. 1980; Hannan et al. 1982). Although the fishes of the upper Cumberland River basin have been the subject of numerous published collections, distributional lists, and descriptions (e.g., Jordan and Swain 1883; Kirsch 1892, 1893; Woolman 1892; Evermann 1918; Jenkins et al. 1972; Starnes and Starnes 1978; Harker et al. 1979, 1980; Burr 1980; Stauffer et al. 1982), thorough ichthyofaunal surveys of tributaries within the drainage have been conducted on only the Big South Fork Cumberland River (Comiskey 1970; Comiskey and Etnier 1972) and Rockcastle River (Small 1970). Because of this paucity of information, we initiated our study of the fishes of the Buck Creek drainage. The study, based on personal collections and museum records, augments the limited published faunal information available for the drainage (Carter and Jones 1969; Harker et al. 1979, 1980).

STUDY AREA

Buck Creek, a fifth-order tributary to the Cumberland River in southeastern Kentucky (Fig. 1), drains approximately 767 sq km of Lincoln, Pulaski, and Rockcastle counties and flows south 107.2 km before discharging into the Cumberland River near river km 859. Impoundment of the river in 1951 to form Cumberland Reservoir permanently ponded several kilometers of the lower portion of Buck Creek, and this influence may extend upstream in excess of 21 km following heavy rainfall. The stream is generally less than 20 m wide and 2 m deep, but achieves a maximum width of approximately 150 m and a maximum depth exceeding 25 m near the mouth. Buck Creek is a high quality stream with clear, well-oxygenated and buffered water (Harker et al. 1979, 1980). The average stream gradient along the mainstem of the creek is 1.25 m/km and is also influenced by Cumberland Reservoir backwaters. According to the United States Army Corps of Engineers (USACE 1976), mean annual flow is 11.7 cu m/second.

Buck Creek lies almost entirely within the Eastern Highland Rim Subsection of the Interior Low Plateaus Physiographic Province (Quarterman and Powell 1978). Surface geology is composed primarily of Mississippian Age limestone deposits with limited exposures of shale bedrock in the northeastern portion of the basin. Karst topography and sinking creeks associated with limestone deposits are common in the watershed, especially south of latitude $37^{\circ} 17'00''$. South of Kentucky route (KY) 80 the stream is deeply entrenched within the western limit of the Cumberland Plateau Section of the Appalachian Plateaus Physiographic Province. This area, associated outlying hills to the west, and much of the extreme eastern boundary of the watershed are overlain with erosion resistant Pennsylvanian Age sandstone. Quaternary Age alluvium is limited to isolated stream channel and floodplain deposits.

Watershed land use is primarily agricultural and secondarily forest. Forested areas are small and scattered except along stream channels and in the part of the watershed south of KY 80, much of which lies within the proclamation boundary of the Daniel Boone National Forest. Coal stripmines and limestone quarries also occur in the watershed south of KY 80 and each comprises less than 1% of the watershed area. Two small (15 and 11 ha) flood control reservoirs were constructed within the Lincoln County part of the watershed by the Soil Conservation Service (T. A. Heard, pers. comm.).

MATERIALS AND METHODS

Fifty-nine collections are reported from thirty-nine collection sites in the Buck Creek drainage (Table 1, Fig. 1). Each collection site includes the stream name, locality, county, and collection date(s). Collections were made by the authors, except as noted, using seines, gill

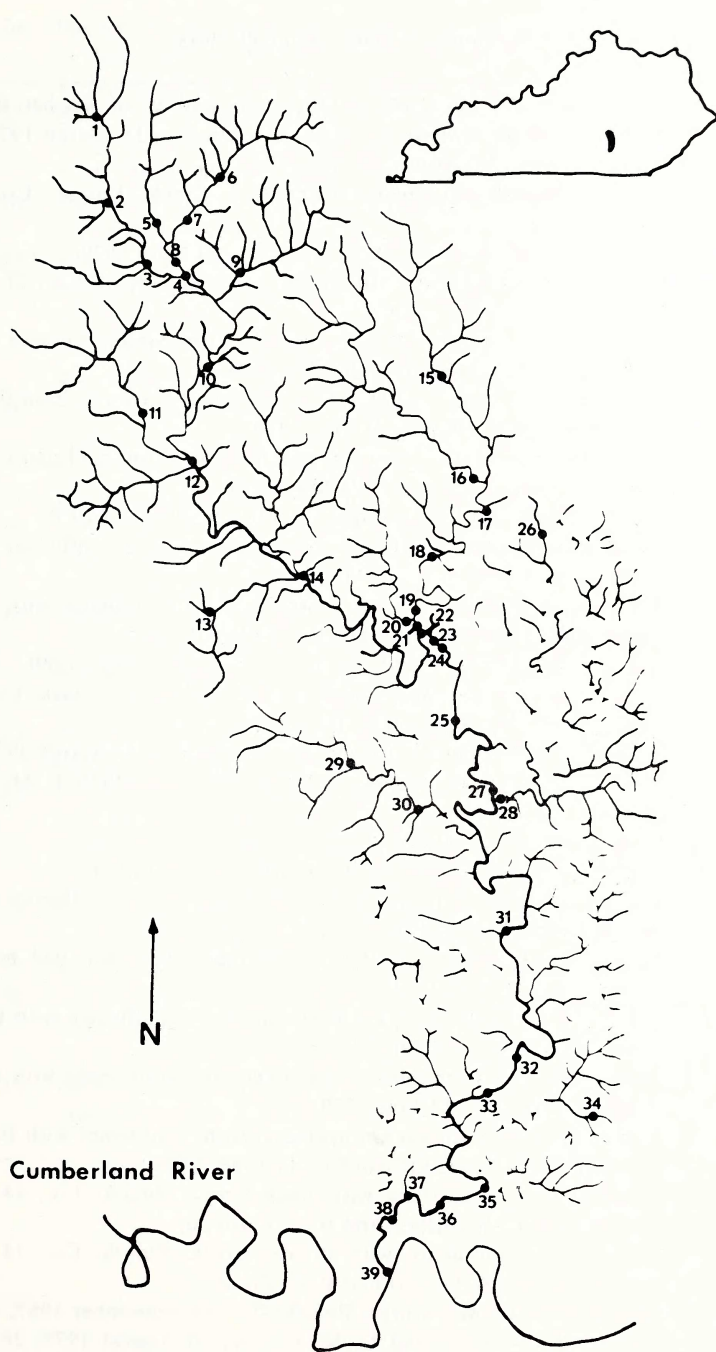


Fig. 1. Map of Buck Creek drainage, Kentucky, showing collection sites.

Table 1. Buck Creek collection sites, dates, and collectors.

Site 1.	Buck Creek, 2.7 km SSW of Ottenheim and W of Kocher Ridge Road and Maple Swamp Road jct, Lincoln Co., 14 March 1977, L. M. Page and C. W. Ronto; 29 April 1979.
2.	Buckeye Branch, confluence with Buck Creek, Pulaski Co., 29 April 1979.
3.	Buck Creek, KY 1781 bridge, Lincoln Co., 29 April 1979.
4.	Buck Creek, confluence with Gilmore Creek, Lincoln Co., 27 September 1980.
5.	Gilmore Creek, 0.5 stream km upstream from confluence with Crab Orchard Creek, Lincoln Co., 20 May 1979.
6.	Crab Orchard Creek, 1.7 km WSW of Broughtontown at Brad Petery Road bridge, Lincoln Co., 21 May 1979.
7.	Crab Orchard Creek, 1.5 stream km upstream from confluence with Gilmore Creek, Lincoln Co., 21 May 1979.
8.	Gilmore Creek, KY 1781 bridge, Lincoln Co., 29 April 1979.
9.	Glade Fork Creek, 1.5 stream km upstream from confluence with Buck Creek, Pulaski Co., 20 May 1979.
10.	Buck Creek, 0.33 stream km upstream from confluence with Bear Den Hollow tributary, Pulaski Co., 20 May 1979.
11.	Caney Creek, KY 1012 bridge, Pulaski Co., 9 November 1980.
12.	Buck Creek, 6.4 km W of Bandy at KY 70 bridge, Pulaski Co., 13 June 1970, L. M. Page and N. D. Penny.
13.	Indian Creek, 2.4 km W of Bobtown, Pulaski Co., 17 March 1976, B. M. Burr, L. M. Page, and M. A. Morris; 19 March 1978, L. M. Page and R. L. Mayden.
14.	Buck Creek, KY 39 bridge, Pulaski Co., 14 March 1981.
15.	Brushy Creek, KY 70 bridge, Rockcastle Co., 17 June 1979.
16.	Bee Lick Creek, 0.6 stream km upstream from confluence with Brushy Creek, Pulaski Co., 19 April 1981.
17.	Brushy Creek, 0.2 stream km downstream from KY 934 bridge, Pulaski Co., 19 April 1981.
18.	Brushy Creek, 5.3 stream km upstream from confluence with Clifty Creek, Pulaski Co., 17 June 1979.
19.	Brushy Creek, 0.1 stream km upstream from confluence with Clifty Creek, Pulaski Co., 17 June 1979.
20.	Clifty Creek, 0.33 stream km upstream from confluence with Brushy Creek at Elrod Road, Pulaski Co., 17 June 1979.
21.	Brushy Creek, confluence with Buck Creek, Pulaski Co., 14 September 1955, C. R. Gilbert and B. C. Franklin.
22.	Buck Creek, confluence with Brushy Creek, Pulaski Co., 14 September 1955, C. R. Gilbert and B. C. Franklin.
23.	Buck Creek, KY 461 bridge, Pulaski Co., 14 September 1967, C. R. Gilbert, W. Seaman, and C. M. Colson; 30 August 1978, 28 September 1980, 14 March 1981; 26 September 1981, B. M. Burr, S. J. Walsh, and T. E. Shepard.

24. Buck Creek, 0.61 km downstream from KY 461 bridge, Pulaski Co., 11 July 1978, S. P. Rice, E. G. Amburgey, R. C. Wilson, and J. R. MacGregor.
 25. Buck Creek, KY 1677 bridge, Pulaski Co., 11 July 1978, S. P. Rice, E. G. Amburgey, R. C. Wilson, and J. R. MacGregor; 9 June 1980. A. W. Berry, M. J. Linville, J. R. MacGregor, and S. P. Rice.
 26. Unnamed stream in Sinking Valley, 1.0 km E of Plato School and 1.4 km NNE of Plato, Pulaski Co., 22 November 1980.
 27. Buck Creek, old KY 80 bridge at Stab, Pulaski Co., 27 July 1954, J. R. Charles; 14 September 1955, C. R. Gilbert and B. C. Franklin; 14 September 1967, C. R. Gilbert, W. Seaman, and C. M. Colson; 28 July 1973, B. A. Branson and D. L. Batch; 22 October 1976, B. M. Burr and L. M. Page; 24 June 1978, 28 October 1980.
 28. Short Creek, opening to downstream cave 0.6 km ESE of old KY 80 bridge at Buck Creek, Pulaski Co., 14 September 1955, C. R. Gilbert and B. C. Franklin; 28 October 1980.
 29. Flat Lick Creek, KY 461 bridge, Pulaski Co., 8 July 1979.
 30. Flat Lick Creek, 1.5 km SSE of Shopville on Heron Cemetery Road and 3.2 km W of Stab, Pulaski Co., 9 November 1980.
 31. Buck Creek, KY 1003 bridge, Pulaski Co., 28 September 1980.
 32. Buck Creek, KY 192 bridge, Pulaski Co., 9 June 1965, R. E. Jenkins, C. Tsai, C. R. Robins, and T. Zorach; 8 September 1966, T. Zorach and R. F. Denoncourt; 19 July 1968, B. A. Branson and D. L. Batch; 28 September 1980, 9 November 1980.
 33. Buck Creek, 2.5 stream km downstream from KY 192 bridge, Pulaski Co., 3 May 1981.
 34. Unnamed stream in Silvers Hollow, 1.7 km NW on KY 192 from jct with KY 1003, Pulaski Co., 7 November 1981.
 35. Buck Creek, 10.6 stream km downstream from KY 192 bridge and 1.6 km SSW of Poplarville, Pulaski Co., 3 May 1981.
 36. Buck Creek, boat ramp off KY 1097, 8.33 stream km upstream from Cumberland River confluence, Pulaski Co., 9 November 1980.
 37. Buck Creek, at Hound Hollow Creek, Pulaski Co., 26 October 1980.
 38. Buck Creek, 4.6 stream km upstream from confluence with Cumberland River, Pulaski Co., 6 April 1981, 23 August 1981, 19 September 1981.
 39. Buck Creek, confluence with Cumberland River, Pulaski Co., 19 September 1981.
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nets, an electroshocker, and an ichthyocide. An effort was made to intensively sample all habitats at each site. Representative specimens of all except two species collected during the current survey were fixed in 10% formalin and stored in 35-40% isopropanol. Except where otherwise indicated, they are housed at the Kentucky Nature Preserves Commission pending museum deposition.

Species composition of 21 mainstem collecting sites were analyzed to determine faunal resemblance using Long's (1963) average resemblance formula, in which:

$$\text{average faunal resemblance} = C(N_1 + N_2)(100) / 2N_1N_2.$$

C is the number of species shared by sites 1 and 2, and N_1 and N_2 are the number of species found at sites 1 and 2, respectively. Relevance values range from 0 to 100, where 0 indicates that sites 1 and 2 have no species in common, and 100 indicates that sites 1 and 2 have identical faunas.

RESULTS

Based on our collections, museum records, and acceptable literature records, the following fishes are known from the Buck Creek drainage. Scientific and common names and the order of presentation follow Robins et al. (1980). Distribution within the drainage is indicated by the terms "generally distributed", "occasional", and "sporadic" as defined by Smith (1965). Collection site numbers are presented for each species, followed in parentheses by the number of specimens collected (if available). Institutions where specimens are deposited and their abbreviations are as follows: Cornell University (CU), Eastern Kentucky University (EKU), Illinois Natural History Survey (INHS), University of Louisville (UL), and University of Michigan Museum of Zoology (UMMZ).

SPECIES ACCOUNTS

Petromyzontidae — lampreys

Ichthyomyzon bdellium (Jordan). Ohio lamprey. Occasional in riffles in late winter and spring. Sites: 23(1), 24(1), 27(1), 32(-).

Lepisosteidae — gars

Lepisosteus osseus (Linnaeus). Longnose gar. Carter and Jones (1969) reported one specimen from Buck Creek below the KY 80 bridge. Our specimens were collected by gill net over a sloping mud bottom from the lower mainstem where the species occurs sporadically. Site: 38(3).

Clupeidae — herrings

Dorosoma cepedianum (Lesueur). Gizzard shad. The gizzard shad was reported by Carter and Jones (1969) from two mainstem sites and was generally distributed and abundant in the lower mainstem. Sites: 32(1), 35(-), 36(3), 38(3), 39(-).

Dorosoma petenense (Günther). Threadfin shad. This species is generally distributed in downstream parts of Buck Creek influenced by Cumberland Reservoir, where it was originally introduced in 1957 as forage for game fish (Henley 1967). Sites: 38(2), 39(-).

Cyprinidae—carps and minnows

Campostoma oligolepis Hubbs and Greene. Largescale stoneroller. This species was reported from Buck Creek as *Campostoma anomalum* (Rafinesque), the central stoneroller, by Carter and Jones (1969) and Harker et al. (1979, 1980). However, Burr (1980) and Stauffer et al. (1982) indicated that the species found in the Cumberland River drainage is *C. oligolepis*. This was the most common and generally distributed species in the drainage. Sites: 1(13), 2(1), 3(5), 4(3), 5(2), 6(1), 7(4), 8(3), 9(1), 10(4), 11(2), 12(34), 13(12), 14(2), 15(1), 18(2), 19(2), 20(2), 21(5), 22(1), 23(16), 24(49), 25(3), 27(27), 28(3), 29(5), 30(1), 31(1), 32(26), 33(1), 38(1).

Cyprinus carpio Linnaeus. Common carp. Several large specimens were collected from the lower mainstem, where the species was generally distributed. Sites: 35(2), 38(1), 39(-).

Ericymba buccata Cope. Silverjaw minnow. This minnow was sporadic in the upper half of the drainage where it was also collected by Harker et al. (1979). Sites: 7(4), 11(2), 14(3), 20(3), 23(1).

Hybopsis amblops (Rafinesque). Bigeye chub. Harker et al. (1979) reported this species from the mainstem. The bigeye chub was generally distributed in the mainstem in or just downstream of riffles flowing over a variety of substrates. Sites: 22(1), 23(4), 24(-), 25(1), 27(33), 31(7), 32(5), 33(5).

Hybopsis dissimilis (Kirtland). Streamline chub. This chub was sporadically distributed in 0.3-0.6 m deep mainstem riffles with moderate current and cobble or boulder substrate. Sites: 27(1), 32(4), 33(2).

Notropis ardens (Cope). Rosefin shiner. This shiner was reported from Buck Creek by Harker et al. (1979, 1980) and was generally distributed throughout the upper half of the drainage. Sites: 1(16), 2(18), 3(13), 4(7), 5(17), 6(13), 7(7), 8(8), 9(21), 10(24), 11(9), 12(43), 14(8), 15(6), 17(8), 18(27), 21(40), 23(47), 24(14), 25(24), 27(38), 29(4), 30(4).

Notropis ariommus (Cope). Popeye shiner. This silt intolerant species (Trautman 1981) was sporadically distributed in the drainage. Site: 21(1), 32(1), 33(3).

Notropis atherinoides Rafinesque. Emerald shiner. Although this species was present in only three collections, further sampling of deep-water, riverine habitat along the mainstem would undoubtedly yield more specimens. Sites: 32(1), 33(1), 36(29).

Notropis boops Gilbert. Bigeye shiner. This shiner was sporadic in the mainstem and tributaries in the upper half of the drainage, where the species was collected from flowing pools and riffles over a generally bedrock bottom. Sites: 3(1), 8(5), 17(2), 18(6), 23(7), 24(3).

Notropis buchanani Meek. Ghost shiner. This large-river species (Smith 1979) was occasional in the lower main channel. Sites: 36(86), 37(6).

Notropis chrysocephalus (Cope). Striped shiner. Carter and Jones (1969) and Harker et al. (1979) reported the striped shiner from Buck Creek, and Harker et al. (1980) collected it in Brushy Creek. The species was generally distributed in clear pools throughout all but the lower part of Buck Creek influenced by Cumberland Reservoir. Site: 1(7), 2(5), 3(2), 4(5), 5(8), 6(2), 7(2), 8(14), 9(2), 10(10), 11(5), 12(35), 14(4), 15(6), 18(1), 21(8), 23(59), 27(4), 32(4).

Notropis galacturus (Cope). Whitetail shiner. Harker et al. (1980) reported specimens of this fish from mainstem Buck Creek. The white-tail shiner was generally distributed in the lower half of the drainage and was often collected with, but was more common than, two other species of the subgenus *Cyprinella*—*Notropis spilopterus* (Cope) and *Notropis whipplei* (Girard). *Notropis galacturus* was commonly collected from riffles flowing over gravel, cobble, or bedrock substrate and from adjacent eddy habitat. Sites: 14(7), 18(2), 19(3), 21(14), 22(5), 23(13), 24(25), 25(3), 27(44), 31(1), 32(12), 33(6).

Notropis photogenis (Cope). Silver shiner. This inhabitant of moderate to large streams (Trautman 1981) was apparently restricted to and sporadically distributed in the lower mainstem of Buck Creek upstream from the influence of Cumberland Reservoir. Sites: 27(1), 31(3), 32(19).

Notropis rubellus (Agassiz). Rosyface shiner. This shiner is generally distributed in the mainstem, where it was also collected by Harker et al. (1979). Sites: 10(2), 14(6), 23(18), 25(1), 27(19), 32(6), 33(12).

Notropis spilopterus (Cope). Spotfin shiner. The spotfin shiner was reported from the Buck Creek mainstem by Harker et al. (1979). We found it generally distributed in the lower half of the drainage exclusive of the area influenced by Cumberland Reservoir. Sites: 21(11), 23(8), 24(12), 27(1), 31(1), 32(-), 33(8).

Notropis telescopus (Cope). Telescope shiner. Harker et al. (1979, 1980) reported the telescope shiner from Buck and Brushy creeks. We found it generally distributed and readily collected from flowing pools and riffles over bedrock or gravel and cobble substrates. Sites: 2(36),

3(2), 8(13), 9(15), 10(2), 11(2), 12(3), 14(9), 15(8), 17(6), 18(10), 19(4), 20(2), 23(93), 24(-), 25(1), 27(37), 32(3).

Notropis whipplei (Girard). Steelcolor shiner. The steelcolor shiner was sporadic in the lower half of the drainage. Sites: 21(2), 32(-), 33(1).

Phoxinus erythrogaster (Rafinesque). Southern redbelly dace. This species was restricted to small headwater streams and was occasional in distribution. Sites: 4(6), 5(6), 7(1), 26(7).

Pimephales notatus (Rafinesque). Bluntnose minnow. Harker et al. (1979, 1980) reported this minnow from Buck and Brushy creeks, where it was the most abundant species. We found it to be generally distributed and one of the most common fishes in the drainage. Sites: 1(18), 2(4), 3(2), 5(1), 6(4), 7(5), 8(8), 9(4), 10(14), 11(4), 12(12), 13(4), 14(4), 15(8), 16(2), 17(3), 18(7), 19(1), 20(1), 21(13), 22(4), 23(17), 24(20), 25(6), 27(18), 29(6), 30(5), 32(-), 33(1).

Pimephales promelas Rafinesque. Fathead minnow. A first-order tributary to a sinking creek in the headwaters of Buck Creek drainage supported a small population of *P. promelas*, but probably represented a bait-bucket introduction. Site: 26(2).

Pimephales vigilax (Baird and Girard). Bullhead minnow. This inhabitant of medium and large streams (Smith 1979) was sporadically distributed in the lower mainstem. Site: 37(2).

Rhinichthys atratulus (Hermann). Blacknose dace. This species was occasional in small headwater streams over gravel substrates. Sites: 1(6), 4(1), 6(1), 9(1), 13(3), 29(9).

Semotilus atromaculatus (Mitchill). Creek chub. This chub was generally distributed and common throughout the upper half of the drainage and present in tributaries in the remainder. Harker et al. (1980) reported specimens from Brushy Creek. Sites: 1(5), 2(2), 4(1), 5(5), 6(4), 7(2), 8(2), 9(3), 10(3), 18(2), 20(3), 21(2), 23(1), 24(2), 26(2), 28(1), 29(1), 30(1), 34(3).

Catostomidae—suckers

Carpiodes cyprinus (Lesueur). Quillback. The quillback occurs sporadically in the lower mainstem of Buck Creek influenced by Cumberland Reservoir. The specimen retained (EKU 1190) measured 35 cm standard length (SL), and was taken by gill net over a mud and debris bottom in water less than 9.1 m deep. Sites: 35(1), 38(2).

Carpiodes velifer (Rafinesque). Highfin carpsucker. Two adult specimens, one (EKU 1190) of which measured 34 cm SL, were taken by gill net from the lower mainstem, where the species occurs sporadically. Site: 38(2).

Catostomus commersoni (Lacépède). White sucker. The white sucker was sporadic in tributaries of Buck Creek. Sites: 2(1), 6(1), 30(1).

Hypentelium nigricans (Lesueur). Northern hog sucker. Carter and Jones (1969) reported this species from all three sites they sampled on Buck Creek, and Harker et al. (1979, 1980) reported specimens from the mainstem and Brushy Creek. The northern hog sucker was generally distributed throughout all but the lower mainstem of Buck Creek and was the most common catostomid in the drainage. Sites: 1(2), 5(2), 6(1), 7(1), 11(1), 12(9), 14(3), 15(1), 18(1), 21(1), 23(5), 24(11), 27(2), 29(2), 30(1), 32(5), 33(1).

Ictiobus bubalus (Rafinesque). Smallmouth buffalo. Three specimens of this typically large-river buffalo (Smith 1979) were collected by gill net from the lower mainstem, where the species occurred sporadically. One specimen was retained (EKU 1190) and measured 39 cm SL. Site: 38(3).

Moxostoma anisurum (Rafinesque). Silver redhorse. One specimen measuring 17.6 cm SL was collected from Buck Creek in 1954 by J. R. Charles (UL 6865) (R. E. Jenkins, pers. comm.); however, exact locality information was not recorded. Site: unknown.

Moxostoma carinatum (Cope). River redhorse. Although the river redhorse has been reported to inhabit medium-size rivers with gravel and rock bottoms and swift or strong flow (Pflieger 1975; Smith 1979), our specimens were collected from the sluggish lower mainstem, where the species occurs sporadically. The specimen collected at Site 35 was taken by gill net in 3.0 m of slowly flowing water over a bottom that graded from mud and debris to rock. Sites: 35(1), 38(3).

Moxostoma duquesnei (Lesueur). Black redhorse. Harker et al. (1979, 1980) reported specimens of this sucker from the mainstem and Brushy Creek. The black redhorse was occasional throughout the Buck Creek drainage. Sites: 3(1), 11(1), 16(1), 24(-), 27(1), 35(2).

Moxostoma erythrurum (Rafinesque). Golden redhorse. Carter and Jones (1969) collected 112 specimens from three sites on the mainstem, some of which were probably misidentified in light of the diverse sucker fauna present in Buck Creek. This was the most generally distributed and common *Moxostoma* in the drainage. Sites: 7(2), 18(2), 19(2), 21(3), 22(8), 23(8), 24(-), 27(4), 33(1).

Moxostoma macrolepidotum (Lesueur). Shorthead redhorse. Only one specimen of the subspecies *M. macrolepidotum breviceps* (CU 52283) has been collected from the drainage (R. E. Jenkins, pers. comm.). Site: 32(1).

Ictaluridae—bullhead catfishes

Ictalurus furcatus (Lesueur). Blue catfish. Several specimens of the blue catfish were collected from the lower mainstem, where the species occurs occasionally. Site: 38(-).

Ictalurus natalis (Lesueur). Yellow bullhead. Carter and Jones (1969) reported a specimen from the mainstem near the KY 39 bridge. Three juvenile specimens of this sporadically distributed species were collected from a drought isolated pool. Site: 4(3).

Ictalurus punctatus (Rafinesque). Channel catfish. One specimen was reported from the mainstem at the KY 80 bridge by Carter and Jones (1969). Although the channel catfish was collected only from the lower mainstem, it is probably widely distributed in the drainage. Sites: 35(1), 38(5).

Noturus flavus Rafinesque. Stonecat. Carter and Jones (1969) reported a specimen of *N. flavus* from the mainstem at the KY 70 bridge. The stonecat was occasional in the lower mainstem exclusive of the area influenced by Cumberland Reservoir. Recent monthly collections at Sites 14, 19, and 32 yielded a dozen additional specimens from under slab boulders and cobble in areas of moderate to swift current. Sites: 21(3), 23(3), 24(-), 25(-), 32(-).

Pylodictis olivaris (Rafinesque). Flathead catfish. Only one specimen was collected from the mainstem; however, the flathead catfish is probably more common and widely distributed along the mainstem. Site: 38(1).

Cyprinodontidae—killifishes

Fundulus catenatus (Storer). Northern studfish. Harker et al. (1979, 1980) reported the northern studfish from Buck and Brushy creeks. We found it common and generally distributed in the upper part of the drainage. Sites: 1(14), 2(4), 3(1), 4(4), 5(2), 6(2), 7(4), 8(5), 9(3), 10(1), 11(2), 12(24), 14(1), 15(2), 16(1), 17(1), 19(2), 20(1), 21(2), 23(12), 24(4), 27(2), 32(1).

Atherinidae—silversides

Labidesthes sicculus (Cope). Brook silverside. The brook silverside was generally distributed in the lower mainstem. Sites: 23(1), 31(2), 32(1), 36(2), 38(2).

Percichthyidae—temperate basses

Morone chrysops (Rafinesque). White bass. Although only one specimen was collected during the survey, Carter and Jones (1969) stated that white bass are harvested by fishermen from Buck Creek near Cumberland Reservoir. Site: 38(1).

Morone saxatilis (Walbaum). Striped bass. This introduced game fish has been stocked in Cumberland Reservoir essentially every year since 1957 (Axon et al. 1982) and, according to a local boat dock operator, is sporadically harvested by anglers from the lower, impounded section. Site: none.

Centrarchidae—sunfishes

Ambloplites rupestris (Rafinesque). Rock bass. The rock bass was reported from the mainstem by Carter and Jones (1969) and Harker et al. (1979) and from Brushy Creek by Harker et al. (1980). It was generally distributed in all but the lower impounded mainstem. Sites: 11(1), 14(1), 15(1), 21(2), 23(4), 24(6), 25(1), 27(3), 29(1), 32(2).

Lepomis cyanellus Rafinesque. Green sunfish. This sunfish was reported by Carter and Jones (1969) and Harker et al. (1979, 1980), and was generally distributed and common in pools throughout the drainage. Sites: 1(1), 5(1), 6(1), 7(2), 8(1), 9(1), 11(1), 15(2), 16(1), 21(1), 24(2), 27(1), 34(3).

Lepomis gulosus (Cuvier). Warmouth. This species was generally distributed in the lower half of the drainage. Sites: 18(1), 32(-), 36(1), 37(2), 38(-).

Lepomis humilis (Girard). Orangespotted sunfish. In Kentucky, this sunfish is sporadic in all but the extreme western part of the state (Burr 1980). Seven specimens (INHS 76015) were collected from a Buck Creek headwater site (L. M. Page, pers. comm.). Site: 1(7).

Lepomis macrochirus Rafinesque. Bluegill. The bluegill was reported from Buck Creek by Carter and Jones (1969) and Harker et al. (1979, 1980). This game fish was generally distributed and common throughout the drainage. Sites: 1(13), 2(3), 4(1), 6(4), 7(1), 8(2), 9(1), 10(2), 12(3), 15(1), 18(1), 21(2), 23(5), 24(1), 25(1), 27(2), 29(2), 31(1), 33(1), 35(1), 36(11), 37(1), 38(3), 39(-).

Lepomis megalotis (Rafinesque). Longear sunfish. Generally distributed and common throughout the drainage, the longear sunfish was previously reported by Carter and Jones (1969) and Harker et al. (1979, 1980). Sites: 1(3), 2(3), 3(4), 7(1), 10(2), 11(1), 12(4), 14(1), 17(1), 19(1), 21(4), 22(3), 23(4), 24(4), 25(2), 27(7), 32(-), 37(2), 38(10).

Lepomis macrochirus x *Lepomis megalotis*. This is a relatively common natural hybrid (Trautman 1981). Site: 23(1).

Lepomis microlophus (Günther). Redear sunfish. One adult specimen of *L. microlophus* was collected from the lower mainstem. As suggested by Burr (1980) in regard to other eastern Kentucky records, this may have resulted from an introduction. Site: 38(1).

Micropterus dolomieu Lacepède. Smallmouth bass. Previously reported from two mainstem Buck Creek sites by Carter and Jones (1969), the smallmouth bass was generally distributed and common throughout the drainage. Sites: 1(1), 2(1), 9(1), 18(1), 23(3), 24(5), 27(2), 32(3), 38(1).

Micropterus punctulatus (Rafinesque). Spotted bass. Carter and Jones (1969) reported the spotted bass from all three mainstem sites

they surveyed. This species was common and generally distributed in the drainage. Sites: 15(1), 19(1), 21(1), 22(1), 23(4), 24(5), 27(3), 31(2), 32(2), 36(7), 37(3), 38(1).

Micropterus salmoides (Lacepède). Largemouth bass. Although reported by Carter and Jones (1969) from a mainstem site and by Harker et al. (1980) from Brushy Creek, the largemouth bass was sporadic in Buck Creek and was collected only from the lower mainstem during our survey. Sites: 32(-), 38(1).

Pomoxis annularis Rafinesque. White crappie. This species was generally distributed and abundant in the lower mainstem influenced by Cumberland Reservoir. Sites: 32(-), 35(2), 38(2), 39(-).

Percidae—perches

Etheostoma blennioides Rafinesque. Greenside darter. Harker et al. (1979, 1980) reported this species from Buck and Brushy creeks. This darter was generally distributed but seldom abundant within the drainage, and was absent from the part influenced by Cumberland Reservoir. Adults were usually collected from substrates that ranged from coarse gravel to boulder riffles with moderate current. Sites: 2(1), 3(2), 5(1), 6(1), 7(3), 8(1), 10(1), 13(1), 15(1), 17(1), 18(1), 19(1), 21(1), 23(3), 24(1), 25(2), 27(45), 31(1), 32(15), 33(1).

Etheostoma caeruleum Storer. Rainbow darter. The rainbow darter was reported by Harker et al. (1979, 1980) from Buck and Brushy creeks. It was the most common and widely distributed darter in the drainage. Collections were made over substrates ranging in size from medium gravel to cobble in slow to moderate current. Sites: 1(26), 2(6), 3(3), 4(2), 5(9), 6(5), 7(3), 8(3), 9(1), 10(5), 11(2), 12(14), 13(2), 14(2), 15(1), 17(4), 18(5), 19(1), 20(2), 21(1), 22(2), 23(36), 24(26), 25(5), 27(14), 31(1), 32(17), 33(2).

Etheostoma camurum (Cope). Bluebreast darter. Harker et al. (1979) reported the bluebreast darter from Buck Creek. It was generally distributed in the swiftest areas of mainstem riffles where substrates varied from coarse gravel to boulders, and was often collected with *Etheostoma maculatum* Kirtland, another species of the subgenus *Nothonotus*. Sites: 12(1), 19(7), 23(3), 24(4), 25(8), 27(1), 31(2), 32(24), 33(3).

Etheostoma cinereum Storer. Ashy darter. This darter is known from Buck Creek as a result of one specimen collected in 1954 (UL 5392) and seven specimens collected in 1955 (UMMZ 171557, 171590) (B. M. Burr, pers. comm.; C. R. Gilbert, pers. comm.). Sites: 22(2), 27(6).

Etheostoma flabellare Rafinesque. Fantail darter. This darter was reported by Harker et al. (1979, 1980) from Buck and Brushy creeks. It was generally distributed in moderate to swift riffles and flowing pools

over fine to coarse gravel in the upper half of the drainage. Sites: 1(6), 2(4), 3(2), 5(3), 6(2), 7(1), 8(2), 9(1), 10(2), 12(24), 13(1), 14(1), 15(2), 17(1), 18(1), 19(2), 21(3), 23(38), 24(9).

Etheostoma maculatum Kirtland. Spotted darter. This species was generally distributed in the lower half of the drainage and often occurred with *E. camurum* under large slab boulders in moderate to swift current. Harker et al (1979) previously reported the spotted darter from Buck Creek. Sites: 14(3), 19(2), 23(6), 24(1), 25(12), 27(14), 31(1), 32(25), 33(1).

Etheostoma spectabile (Agassiz). Orangethroat darter. One somewhat aberrant specimen (INHS 87624) (L. M. Page, pers. comm.) was collected from a small, headwater tributary. Site: 2(1).

Etheostoma stigmaeum (Jordan). Speckled darter. Harker et al. (1979, 1980) reported the speckled darter from Buck and Brushy creeks. It was generally distributed and was often collected in sluggish runs over a silty-sand substrate. However, adults were occasionally taken from the margins of coarse gravel riffles. Sites: 1(4), 3(5), 5(1), 8(1), 10(7), 12(5), 14(3), 16(1), 21(3), 22(2), 23(5), 24(8), 25(5), 27(6), 31(2), 32(5).

Etheostoma virgatum (Jordan). Striped darter. Harker et al. (1979, 1980) reported this species from Buck and Brushy creeks. The striped darter was generally distributed and, as reported by Page and Schemske (1978), is the only slab-pool *Catnotus* occupying the drainage. Sites: 1(20), 3(7), 4(2), 5(3), 7(1), 8(1), 10(2), 11(1), 12(1), 14(3), 15(1), 16(2), 17(2), 18(1), 20(1), 21(7), 22(1), 23(5), 24(7), 25(1), 27(4), 29(2).

Etheostoma zonale (Cope). Banded darter. The banded darter was occasional in the mainstem of lower Buck Creek. We collected it from the interstices of gravel over swift, boulder and bedrock riffles. Sites: 23(1), 24(3), 25(2), 27(6), 32(11).

Percina caprodes (Rafineque). Logperch. The logperch was reported from mainstem Buck Creek by Carter and Jones (1969) and Harker et al. (1979). Generally distributed along the Buck Creek mainstem, it was collected from a variety of habitats ranging from swift, cobble and boulder riffles to a slow flowing, silt covered bedrock pool. Sites: 10(2), 19(1), 22(1), 23(1), 24(2), 25(2), 27(4), 31(1), 32(13), 33(2), 36(2), 37(1).

Percina maculata (Girard). Blackside darter. Since the only collections of this percid were two made in 1955 (C. R. Gilbert, pers. comm.), the species is either sporadically distributed or possibly extirpated from Buck Creek. Sites: 21(1), 27(1).

Stizostedion canadense (Smith). Sauger. This species was apparently sporadic in the lower mainstem of Buck Creek where, according to a local boat dock operator, it is harvested irregularly by fishermen. Site: none.

Stizostedion vitreum (Mitchill). Walleye. According to a local boat

dock operator, fishermen sporadically harvest walleye from the lower mainstem. Site: 38(1).

Sciaenidae—drums

Aplodinotus grunniens Rafinesque. Freshwater drum. This primarily large-river fish (Smith 1979) was reported by Carter and Jones (1969) and was generally distributed in the lower mainstem. Sites: 32(1), 38(2), 39(-).

Cottidae—sculpins

Cottus carolinae (Gill). Banded sculpin. The banded sculpin was reported by Harker et al. (1979) and was occasional in moderate to swift riffles containing cobble and boulders. Sites: 25(1), 27(5), 28(7), 32(10), 33(1).

DISCUSSION

Seventy-three species of fishes and one hybrid, representing 13 families, were found to occur in the Buck Creek drainage. Approximately 80% consisted of members of the Cyprinidae (23 species), Percidae (14), Centrarchidae (11), and Catostomidae (10). Of the 121 species reported by Burr (1980) from the upper Cumberland River drainage in Kentucky, 70 are known to occur in Buck Creek. Of the remaining 51 species, 21 are known from adjacent streams or Cumberland Reservoir and potentially occur in Buck Creek (Table 2).

New distributional records were obtained for *Ictiobus bubalus*, *Ictalurus furcatus*, and *Lepomis microlophus* in the upper Cumberland River drainage, and the continued existence of *Carpionodes velifer* within the drainage was confirmed. Within the Cumberland River drainage, *Ictiobus bubalus* was formerly known to occur only in the lower part of the river in western Kentucky, which has been impounded to create Barkley Reservoir (Burr 1980; Lee 1980). Our collection extends the known range of *I. bubalus* in the Cumberland River upstream approximately 854 km from the nearest downstream collection made at river km 4.8 (D. A. Etnier, pers. comm.). *Ictalurus furcatus* had not previously been collected from the upper Cumberland River drainage of Kentucky (Burr 1980). It was not entirely unexpected, however, since specimens have been taken from the river in adjacent Tennessee (Glodek 1980; D. A. Etnier, pers. comm.). *Lepomis microlophus* is sporadic and uncommon throughout the state, except in the upper Cumberland River drainage (Burr 1980). Although the specimen from Buck Creek represents the first record for the upper Cumberland River drainage, the redear sunfish has been widely stocked in impoundments and is probably not native to the drainage. *Carpionodes velifer* is sporadically distributed in the eastern half of Kentucky (Burr 1980) and was previously

known from the upper Cumberland River drainage as a result of two 1925 collections deposited at UMMZ (B. M. Burr, pers. comm.). The highfin carpsucker persists in the upper Cumberland River drainage despite extensive habitat alteration resulting from impoundment of 162 km of the mainstem Cumberland River and pollution from coal mining. These records lend credence to speculation that other fishes, especially large-river forms, may be collected from the Buck Creek drainage (Table 2), and emphasize the need to sample such habitat during faunal surveys.

A total of 14 specimens of *Ericymba buccata* was collected from five sites in the Buck Creek drainage by Harker et al. (1979) and during this survey. Moreover, four additional specimens (EKU 1215) were recently collected from the adjacent Pitman Creek drainage, Pulaski County. These new records significantly expand the range of the silverjaw minnow in the upper Cumberland River drainage as depicted by Burr et al. (1980) and Gilbert (1980a). Buck Creek has been rather well collected (B. M. Burr, pers. comm.), which suggests that the silverjaw minnow has only recently dispersed into the Buck and Pitman creek drainages. However, its current distribution closely approximates the upper Cumberland River drainage on the Cumberland Plateau before the upstream migration of Cumberland Falls, suggesting that the species was simply overlooked by previous investigators. According to McGrain (1966), Cumberland Falls originated on the Pottsville escarpment near Burnside, Kentucky, and has eroded into the Cumberland Plateau approximately 72 km to its present location. Prior to the retreat of the falls, Buck Creek was the most downstream major tributary to the Cumberland River above the falls, while Pitman Creek and Big South Fork Cumberland River discharged below the falls. Thus, *E. buccata* is now known to occupy all major tributaries to the Cumberland River upstream from the apparent original location of Cumberland Falls. Although it may have been introduced into Buck and Pitman creeks via bait bucket transfer, Burr et al. (1980) mentioned evidence of recent range expansion by the silverjaw minnow in other states and discussed the implications of several newly discovered, isolated populations in the lower Green and Tradewater rivers of Kentucky.

Several alternative mechanisms for the dispersal of *E. buccata* into Buck and Pitman creeks, are available. The first involves movement through subsurface channels, which potentially connect Buck Creek with adjacent drainages. Karst topography including numerous sinkholes and subterranean streams is common in the Buck Creek drainage and extends east and northeast to the Dix and Rockcastle river drainages and west to the Pitman Creek drainage. *Ericymba buccata* is present in the Dix River and western tributaries to the Rockcastle River (Burr et

Table 2. Species that potentially occur in Buck Creek, their locality of occurrence and source.

Species	Locality of occurrence	Source
<i>Ichthyomyzon greeleyi</i>	Little South Fork	Comiskey and Etnier (1972)
<i>Lampetra aepyptera</i>	Taylor Branch, Youngs Creek, and Clear Creek	Walsh and Burr (1981)
<i>Acipenser fulvescens</i>	Cumberland River	Burr (1980)
<i>Polyodon spathula</i>	Cumberland Reservoir	Henley (1967), Charles et al. (1979), Axon et al. (1980)
<i>Anguilla rostrata</i>	Statewide	Burr (1980)
<i>Hiodon alosoides</i>	Cumberland River	Gilbert (1980b)
<i>Hiodon tergisus</i>	Cumberland Reservoir	Henley (1967), Charles et al. (1979), Axon et al. (1980, 1982)
<i>Esox americanus</i>	Cumberland Reservoir	Henley (1967)
<i>Carassius auratus</i>	Cumberland Reservoir	Henley (1967)
<i>Hybopsis storeriana</i>	Cumberland River	Gilbert (1980c)
<i>Notropis leuciodus</i>	Fishing Creek	Harker et al. (1980)
	Little South Fork	Comiskey and Etnier (1972)
<i>Notropis volucellus</i>	Rockcastle River	Gilbert and Burgess (1980)
	Rock Creek	Harker et al. (1979)
	Little South Fork	Harker et al. (1979)
<i>Notropis</i> sp. (undescribed sawfin shiner)	Pitman Creek	Warren (1981)
	Big South Fork	Burr (1980)
<i>Carpionodes carpio</i>	Cumberland River	Burr (1980)
<i>Ictiobus cyprinellus</i>	Obey River	Lee and Shute (1980)
	Wolf Creek	Burr (pers. comm.)
<i>Minytrema melanops</i>	Cumberland Reservoir	Henley (1967)
<i>Ictalurus melas</i>	Cumberland Reservoir	Henley (1967)
<i>Fundulus notatus</i>	Cumberland Reservoir	Henley (1967)
<i>Gambusia affinis</i>	Cumberland Reservoir	Henley (1967)
	Upper Cumberland River	Burr (1980)
<i>Pomoxis nigromaculatus</i>	Cumberland Reservoir	Henley (1967), Charles et al. (1979), Axon et al. (1980, 1982)
<i>Percina sciera</i>	Pitman Creek	Page (1980)
	Big South Fork	Page (1980)

al. 1980; Gilbert 1980a; Branson and Batch 1981) and could have actively or passively moved via subsurface channels into Buck Creek and from there into Pitman Creek. Dispersal through Cumberland River Reservoir constitutes the second mechanism. Guillory (1978) discussed active and passive dispersal via the main channel of the lower Mississippi River by *Notropis longirostris* (Hay), a small-stream species. Burr et al. (1980) interpreted the presence of *E. buccata* in the Green River main channel as evidence of direct dispersal to tributary streams. The final mechanism, stream capture, is plausible, but potential sites of piracy with adjacent drainages could not be identified. Whether *E. buccata* is expanding its range or is limited to the Cumberland River drainage on the Cumberland Plateau and Pitman Creek can only be determined by periodic surveys of the Fishing Creek and Big South Fork Cumberland River fish faunas, which apparently do not currently include this species (Comiskey and Etnier 1972; Harker et al. 1980).

Two species assigned protection status in Kentucky by the Kentucky Academy of Science (Branson et al. 1981) are known from the Buck Creek drainage. *Notropis ariommus* was listed as of undetermined status but must be considered rare in Buck Creek, from which only 5 specimens are known. *Etheostoma cinereum* was listed as endangered and is known from only four drainages within the Cumberland river system of Kentucky, including Buck Creek (Burr 1980; Warren 1981). This large-stream and river darter prefers cover such as boulders, undercut banks, and rubble-gravel substrate mixed with detritus and/or *Justicia americana* in sluggish current adjacent to swift shoals (Saylor 1980; Warren 1981). Although the ashy darter has not been collected from Buck Creek since 1955, it may persist in suitable habitat along the mainstem between KY 80 and KY 192.

Three faunal units were discerned when the fish faunas of the 21 mainstem collecting sites were analyzed to determine average faunal resemblance (Table 3). The units were comprised by sites 1-27, 31-33, and 35-39, respectively, (hereinafter referred to as Units 1, 2, and 3) based on greater than 50% shared fauna. Divergence from this standard within each unit is attributed to sampling artifact.

The fauna of Unit 3 (Table 4) was characteristic of low-gradient habitats such as lakes, impoundments, and medium-to-large rivers (Pflieger 1975; Smith 1979; Trautman 1981) and was markedly different from that of the other units. Fifteen of the twenty-nine species collected from Unit 3 were limited in distribution to this section of Buck Creek.

Faunal differences were less pronounced between the two remaining units (Table 3). Sites 1-14 were faunistically similar to 21-27 but generally shared 40% or less of the fauna with Unit 2 (sites 31-33). Sites 21-27

generally shared 50% or more of the fauna with sites 31-33 and exhibited a gradual increase in similarity to these sites with each successively closer site. The transitional nature of the fauna of sites 21-27 relative to sites 1-14 and 31-33 is reflected by faunal resemblance values calculated by pooling the fauna of each group of sites. Sites 21-27 had 72% and 79% shared fauna with 1-14 and 32-33, respectively. Sites 1-14 and 31-33 had 49% shared fauna.

Analysis of the species characteristic of Units 1 and 2, based upon the occurrence of a species in greater than 50% of the sites comprising each unit, further illustrates the distinctions and similarities between the two units (Table 4). Species characteristic of Unit 1 included *Notropis ardens*, *N. chrysocephalus*, *N. telescopus*, *Semotilus atromaculatus*, *Fundulus catenatus*, *Etheostoma flabellare*, and *E. virgatum*. These are generally creek or small-stream fishes that migrate downstream in fall to overwinter in larger and deeper waters (Pflieger 1975; Smith 1979; Trautman 1981) such as that present in sites 21-27. *Hybopsis amblops*, *H. dissimilis*, *Notropis ariommus*, *N. atherinoides*, *N. photogenis*, *N. rubellus*, *N. spilopterus*, *N. whipplei*, *Labidesthes sicculus*, *Etheostoma camurum*, *E. maculatum*, and *Cottus carolinae* were characteristic of Unit 2 and typically inhabit moderate-to-large streams and small rivers (Pflieger 1975; Etnier 1976; Smith 1979; Trautman 1981). Elsewhere in Buck Creek these fishes were collected almost exclusively from the downstream portion of Unit 1, sites 21-27. This indicates that sites 21-27 supported a mixture of small-stream, large-stream, and small-river fishes and may be considered an area of transition between the faunas of Units 1 and 2. Several species were excluded from this analysis because they: (1) were collected from sites in all three units and were considered ubiquitous (*Campostoma oligolepis*, *Lepomis macrochirus*, *L. megalotis*, *Micropterus dolomieu*, and *Percina caprodes*), or (2) occurred extensively throughout Units 1 and 2 and were thus not useful in identifying differences between these units (*N. galacturus*, *Pimephales notatus*, *Hypentelium nigricans*, *Etheostoma blennioides*, *E. caeruleum*, and *E. stigmaeum*).

The pattern of longitudinal distribution of fishes along the Buck Creek mainstem was similar to that reported by Guillory (1982) for a Louisiana stream, and involved: (1) the addition of species in the middle section of Buck Creek (sites 21-33) to those widely distributed throughout sites 1-27, and (2) replacement of upper- and middle-river species with those typical of low-gradient, big-river habitat in the lower impounded section of Buck Creek (Table 4). A general downstream increase in the number of species was also noted (Table 4) and has been reported for other streams (Kuehne 1962; Larimore and Smith 1963; Sheldon 1968; Lotrich 1973; Guillory 1982). We believe that this pattern

would have been more distinct if an additional collection site in the intermittent headwaters of Buck Creek had been established, and through further sampling of deepwater habitat in the downstream section of Unit 2 and in Unit 3.

The faunas of each unit are a product of the diverse conditions found among the units. Numerous physicochemical factors that determine stream habitat diversity have been correlated with the longitudinal succession of stream fishes. These factors include, but are not limited to, depth (Sheldon 1968), drainage area (Larimore and Smith 1963), gradient (Trautman 1942; Burton and Odum 1945), pool size (Minckley 1963), stream order (Kuehne 1962; Lotrich 1973), and stream width (Burton and Odum 1945). Physicochemical factors excluded as primary causes of observed faunal differences between the upper and middle sections of Buck Creek included water quality, which Harker et al. (1979, 1980) reported as similar between the two areas, and substrate, which was characteristically cobble, slab boulder, and bedrock throughout the stream.

Observed faunal differences probably resulted from the interrelationship of numerous physicochemical factors as postulated by Guillory (1982). Since species characteristic of faunal Unit 1 of Buck Creek were also an important component of the Unit 2 fauna, the habitat requirements of additional species characteristic of Unit 2 may explain faunal differences (Table 4). These species (e.g., *N. atherinoides*, *N. photogenis*, *H. dissimilis*, *E. camurum*, *E. maculatum*) typically inhabit moderate-to-large streams and rivers and are thus adapted to relatively stable environments. We speculate that factors such as discharge and permanence of flow are important determinants of faunal differences observed between Units 1 and 2. These factors, which are more constant in the large-stream or small-river habitat of Unit 2 than Unit 1, are closely interrelated with several of the previously cited physicochemical factors, and are important to the maintenance of a stable environment.

The fauna of the lower impounded river was also related to the type of habitat present. Within this part of Buck Creek gradient is low and the stream is deep (10-25 m), providing habitat suitable for large-river and lentic species (Table 4).

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